PRINT YOUR NAME:

PRINT YOUR X.500 ID:

PRINT YOUR TA’S NAME:

WHAT RECITATION SECTION ARE YOU IN?

Closed book, closed notes, no calculators/PDAs; no reference materials of any kind. Turn off all handheld devices, including cell phones.

Show work; a correct answer, by itself, may be insufficient for credit. Arithmetic need not be simplified, unless the problem requests it.
I. Multiple choice

A. (5 pts) (no partial credit) Let \( y = x^2 + x \). Compute \( dy \), evaluated at \( x = 10, \ dx = 0.1 \). Circle one of the following answers:

(a) 1.22
(b) 1.2
(c) 2.11
(d) 2.1
(e) NONE OF THE ABOVE

B. (5 pts) (no partial credit) Find the derivative of \((2 + x^4)^{\sin x}\) w.r.t. \( x \). Circle one of the following answers:

(a) \([(2 + x^4)^{\sin x}][(\sin x)(\ln(2 + x^4)) + (\cos x)(4x^3/(2 + x^4)))]
(b) \([(2 + x^4)^{\sin x}][\cos x(\ln(2 + x^4)) + (\sin x)(4x^3/(2 + x^4))]
(c) \([(2 + x^4)^{\sin x}][(\sin x)(\ln(2 + x^4))]
(d) \([(2 + x^4)^{\sin x}][(\cos x)(4x^3/(2 + x^4))]
(e) NONE OF THE ABOVE

C. (5 pts) (no partial credit) Suppose \( f''(x) = (x-7)^3(x-8)^4 \). At most one of the following statements is true. If one is, circle it. Otherwise, circle “NONE OF THE ABOVE”.

(a) \( f \) is concave down on \((-\infty, 7]\) and up on \([7, \infty])\].
(b) \( f \) is concave up on \((-\infty, 7]\) and down on \([7, \infty])\].
(c) \( f \) is concave up on \((-\infty, 7], \) down on \([7, 8] \) and up on \([8, \infty)\].
(d) \( f \) is concave down on \((-\infty, 7], \) up on \([7, 8] \) and down on \([8, \infty)\].
(e) NONE OF THE ABOVE
D. (5 pts) (no partial credit) Let \( f(x) = e^{3x^4 - 4} \). Recall that \( L_2S_1^5f \) denotes the left endpoint Riemann sum, from 1 to 5, of \( f \), with two subintervals. Which of these is equal to \( L_2S_1^5f \)? Circle one of the following answers:

(a) \( e^5 + e^{11} \)  
(b) \( e^2 + e^8 \)  
(c) \( 2(e^5 + e^{11}) \)  
(d) \( 2(e^2 + e^8) \)  
(e) NONE OF THE ABOVE

E. (5 pts) (no partial credit) Let \( f(x) = e^{2x} + 3x \). What is the iterative formula of Newton’s method used to solve \( f(x) = 0 \)? Circle one of the following answers:

(a) \( x_{n+1} = x_n - \frac{e^{2x_n} + 3x_n}{2e^{2x_n} + 3} \)  
(b) \( x_{n+1} = x_n - \frac{2e^{2x_n} + 3}{e^{2x_n} + 3x_n} \)  
(c) \( x_{n+1} = x_n - \frac{e^{2x_n} + 3x_n}{e^{2x_n} + 3} \)  
(d) \( x_{n+1} = x_n - \frac{e^{2x_n} + 3}{e^{2x_n} + 3x_n} \)  
(e) NONE OF THE ABOVE

F. (5 pts) (no partial credit) Let \( f(x) = \tan^2(5x^4 + 1) \). Compute \( \int_{-1}^{-1} f(x) \, dx \). Circle one of the following answers:

(a) \(-1\)  
(b) \(-\sqrt{2}/2\)  
(c) \(0\)  
(d) \(20\)  
(e) NONE OF THE ABOVE
II. True or false (no partial credit):

a. (5 pts) Let $f, g : \mathbb{R} \to \mathbb{R}$ be any two differentiable functions such that, for all $x \in \mathbb{R}$, $f'(x) = g'(x)$. Then $f = g$.

b. (5 pts) Let $f : \mathbb{R} \to \mathbb{R}$ be any function such that $f'(2) = 0$ and $f''(2) > 0$. Assume that $f''$ is defined on $\mathbb{R}$. Then $f$ has a local minimum at 2.

c. (5 pts) Assume that $\lim_{x \to a} [f(x)] = 1 = \lim_{x \to a} [g(x)]$. Assume also that $\lim_{x \to a} \frac{f'(x)}{g'(x)} = 3$. Then $\lim_{x \to a} \frac{f(x)}{g(x)} = 3$.

d. (5 pts) If $f$ is continuous on $[a, b]$, then $\int_{a}^{b} (f(x)) \, dx = \lim_{n \to \infty} [L_{n}S_{a}^{b}f]$.

e. (5 pts) $\frac{d}{dx} \left[ \int_{1}^{x} \sin(e^{t}) \, dt \right] = \cos(e^{x})$. 

THE BOTTOM OF THIS PAGE IS FOR TOTALING SCORES
PLEASE DO NOT WRITE BELOW THE LINE

VERSION C
I. A,B,C
I. D,E,F
II. a,b,c,d,e
III. 1.
III. 2.
III. 3.
III. 4.
III. Computations. Show work. Unless otherwise specified, answers must be exactly correct, but can be left in any form easily calculated on a standard calculator.

1. (10 pts) Find an antiderivative w.r.t. $x$ of $\cos^2(x - 3)$. (Hint: $\cos(2\theta) = -1 + 2(\cos^2 \theta)$.)
2. (10 pts) Let $f(x) = \int_x^{x^4} \sqrt{2t + 8t^2 + 6} \, dt$. Compute $f'(1)$. 
3. (15 pts) We are asked to design a large cup in the shape of an inverted (i.e., upside down) cone. The cup is to have an open top, and must contain $\pi/3$ cubic feet of volume inside. Let $r$ be the radius of the top of the cup. On the interval $r > 0$, find the choice of $r$ (in feet) that minimizes the surface area, $A$, of the cup. (HINT: Our local precalculus expert shows us the formula that relates $A$ to $r$. It is $A = (\pi r)\sqrt{r^2 + r^{-4}}$.)
4. (10 pts) A square-based pyramid is growing. Its height is always equal to the length, \( s \), of the sides of its base. Assume that its volume is always growing at a rate of 10 cubic feet per minute. Find the rate of growth in \( s \) (in feet per minute) at the moment when the volume is 9 cubic feet. (HINT: According to our local precalculus expert, its volume, \( V \), is given by \( V = \frac{s^3}{3} \).)